between said power supply means and each said circuit sector connected thereto; and providing voltage clamping means in each said power transfer path between at least two said circuit sectors having different clamping voltages, for reducing the maximum voltage which may be applied by one of said at least two circuit sectors to another of said at least two circuit sectors.

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~~30~~. (New) A method according to claim ~~29~~, including providing power limiting means in each said power transfer path in the intrinsically safe circuit so as to limit the maximum power transfer values between adjacent circuit sectors to values less than a predetermined threshold value at which combustion in said hazardous environment is initiated.

REMARKS

Twenty-one claims were originally filed in this case, and all claims were rejected. Claims 1-11 and 16 have been canceled. Claims 12, 14, 16, 17 and 18-21 have been amended. New claims 22-29 have been added. Reconsideration of the application in view of the above changes and the following remarks is respectfully requested.

The Examiner will note that amended claim 12 now states specifically that the plurality of circuit sectors are located in the hazardous environment. The amended claim 12 also now includes power supply means, also located in the hazardous environment, with power limiting means being provided between the power supply means and each circuit sector which is connected thereto. We would draw the Examiner's attention to the fact that

in the cited Hoeflich patent although circuit sectors are located in the hazardous environment, the power supply means is located in the safe zone. In this respect, therefore, amended claim 12 is clearly novel over Hoeflich.

Moreover, amended claim 12 includes the feature that at least two of the circuit sectors which have one or more power transfer paths therebetween have different sparking voltages. The circuit claimed in claim 12 also includes voltage clamping means in each said power transfer path between two such circuit sectors having different sparking voltages. We would draw the Examiner's attention to the fact that in Hoeflich the only voltage clamping means provided in the circuit are the MPAs 24, 21. The MPA 24 is connected between the power supply 10 and one of the CMOS logic modules 34. Each of the MPAs 21 is connected between the power supply 10 and one of the loads 17. In Hoeflich, there are no voltage clamping means provided between adjacent circuit sectors (i.e. two circuit sectors having at least one power transfer path therebetween). The only power limiting means providing between adjacent circuit sectors is current limiting means in the form of the DSAs 38. (See column 6, lines 51 to 55 of Hoeflich). Additionally, Hoeflich does not disclose or suggest the possibility of different ones of the circuit sectors having different sparking voltages.

For the foregoing reasons we respectfully submit that amended claim 12 is clearly novel over Hoeflich.

We also respectfully submit that amended claim 12 is inventive over Hoeflich, for reasons which will now be explained. A significant problem which Hoeflich fails to mention, consider or address is that at least one or more of the circuit sectors may include therein voltage enhancing devices; i.e. the circuit sector may generate a voltage which exceeds the original input voltage to the circuit. For example, as in the case of the circuit

shown in Fig. 9 of the present application, an LCD display sector will normally include voltage rails at different voltages e.g. a +6 volts rail and a –21 volts rail, while an adjacent circuit connected thereto, such as the CPU sector of Fig. 9, only has one voltage level i.e. +6 volts.

In Hoeflich, it is assumed that only the voltage from the power supply has to be limited. This is clearly stated at column 6, lines 55 to 58 of Hoeflich which states that the voltage limiting MPA assemblies are not required in the DSAs 38 (which are in power transfer paths between adjacent circuit sectors) "because the voltage level is already limited by MPA 24". The MPA 24 is only connected between the power supply 10 and the loads 17, as above-mentioned. Thus, Hoeflich does not consider the possibility that any of the loads 17 may have voltage generating devices therein which cause the sparking voltage of the load 17 to be greater than the sparking voltage of the power supply 10.

By relying on the circuit arrangement of Hoeflich, where only voltage from the power supply is voltage clamped, it would not be possible to build a circuit in which any of the sectors include voltage enhancing devices as above-described, such as the circuits of Figs. 4 & 5 of the present application, for example. In practice, it would not be possible to build any complicated intrinsically safe device without taking into account this fact that adjacent sectors may have different sparking voltages, and providing voltage clamping means between one or more pairs of adjacent sectors having different sparking voltages.

For the avoidance of doubt, we would draw the Examiner's attention to the fact that power transfer paths do exist between the display modules 17 in Fig. 1 of Hoeflich by virtue of the electrical connections between the CMOS logic modules 34 and the display module 17, in which power transfer paths only the DSAs 38 are present to limit current. The MPAs

21 are only present in the power transfer path between each display module 17 and the power supply 10. Moreover, as already noted by the Examiner the CMOS logic modules 34 each constitute a "circuit sector", and there is clearly only a DSA 38 between the CMOS logic modules 34 and the display modules 17. Thus, if any of the display modules 17 have different sparking voltages from each other, and/or have different sparking voltages to the CMOS logic module 34, in the case of a circuit failure or shorting therein it would be possible for the sparking voltage of a display module 17 to be applied to one or more of the CMOS logic modules 34 or another display module 17 by virtue of the power transfer paths therebetween, resulting in power transfer therebetween. This could have disastrous consequences where this power transfer exceeds a value at which combustion in the hazardous environment in which the circuit is situated, is initiated.

A further problem with Hoeflich is that it appears to equate energy and power, when in fact the two are not the same. Hoeflich refers only to energy storage (see column 3, lines 7 to 13; column 3 line 46; column 2, lines 3, 7 to 9, 59; column 6, line 65 to 68; column 7, lines 31 to 33) and does not specifically allow for power dissipation between sectors. Only power transfer from the power supply means 10 to the circuit sectors is considered and limited by the MPAs 24, 21. In contrast, in the present invention as claimed in amended claim 12, we consider and limit power which can be dissipated between at least two adjacent circuit sectors.

A further significant disadvantage of the circuit of Hoeflich, is the location of the power supply 10, and also data communications paths 12, in the safe area, separate from the hazardous area. A problem with this type of circuit is often referred to as the "double earth fault" condition. This can occur where two or more earth wires are run from the safe zone

into the hazardous zone. Faults can development in the safe zone, since is uncontrolled (i.e. it is not an intrinsically safe circuit area), and such faults can cause current to flow along one earth wire out into the hazardous area and back through the second earth wire into the safe area. This current can be so high as to cause an explosion risk. In order to prevent such a double earth fault condition arising in the Hoeflich circuit, Hoeflich must include the optocouplers 53 between the data communications path 12 and the hazardous area. Use of such optocouplers is undesirable since there are only 2 such devices certified and approved for use in intrinsically safe circuits and they are relatively slow (less than 10-kilohertz bandwidth). Voltage clamping means in the form of zenar barriers, for example, allow a much higher band width inter-sector communication to be achieved. In the circuit claimed in the present application inter-sector communication does not take place via the safe area, and such optocouplers are not required.

Further advantage of the circuit claimed in the present application is obviously that it is not necessary to be tethered to the safe area via a wire connecting the power supply to the circuit sectors, since the power supply is located in the hazardous area.

For the above reasons we respectfully submit that amended claim 12 is both novel and non-obvious over Hoeflich.

Claims 13-15, 17-28 are dependent on claim 12, and therfore are believed to be patentably distinct over the cited art for the reasons identified and also because of the additional novel structure that each of these claims recited. The Applicant notes that the new claims 22-28 generally corresond to claims 3-6 that have now been canceled. These claims have been re-written for clarity and consistency with independent claim 12.

The only other independent claim is new claim 29, which is a method claim drafted to use wording corresponding to the wording of apparatus claim 12, and we submit that new claim 29 is also novel and inventive for the reasons already outlined above.

Applicant respectfully requests a one-month extension of time in responding to the above-identified office action and has also enclosed a check for the requisite fee for the one-month extension of time in responding to the above-identified office action.

In the event that the Examiner continues one or more of his rejections, however, he is respectfully requested to enter the amendments into the case at this time in order to clarify the issues for appeal. If the Examiner believes that direct contact with applicant's attorney would help advance the prosecution of this case to finality, he is invited to telephone the undersigned at the number given below.

In view of the foregoing arguments, Applicants respectfully submit that the claims presently in this case are now in condition for allowance. Reconsideration and prompt favorable action are therefore solicited.

Respectfully submitted,
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